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Freshwater Fishes of Sungai Chantek, Pasir Akar, Besut, Terengganu, Peninsular Malaysia

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ABSTRACT

Twenty two species from 12 families of primary freshwater fishes were recorded from Sg. Chantek, Pasik Akar, Besut, Terengganu. Cyprinidae was the most dominant family (27%) with six species followed by Balitoridae with four species (18%). Fish composition was dominated by *Poropuntius smedleyi* with 140 individuals collected. More fish were collected in the downstream section (LS) (85 individuals) compare to middle (MS) and upper stream (US) sections. Fish species richness for each section range from 12 (US) to 18 (LS) and the differences was between US-LS and MS-LS sections but not with US-MS. LS has more fish species compared to US and MS. It is hypothesized that the presence of different substrate types and microhabitats at LS promotes species richness. Despite of its small size stream, the ichthyofauna found at Sungai Chantek are important and should be kept intact. This study has successfully documented fish diversity at Sg. Chantek. It is suggested that continuous monitoring to be undertaken to ensure species diversity is preserved.

Keywords: Fish, inland, small stream, species richness

ABSTRAK

Dua puluh dua spesies dari 12 famili ikan air tawar primari telah direkodkan dari Sg. Chantek, Pasik Akar, Besut, Terengganu. Cyprinidae merupakan famili yang paling dominan (27%) dengan enam spesies diikuti oleh Balitoridae dengan empat spesies (18%). Komposisi ikan didominasi oleh *Poropuntius smedleyi* dengan 140 individu telah dikutip. Lebih banyak ikan dikutip di bahagian hilir (LS) (85 individu) berbanding bahagian tengah (MS) dan hulu sungai (US). Kekayaan spesies ikan di setiap bahagian dalam julat dari 12 (US) ke 18 (LS) spesies dan terdapat perbezaan di antara US-LS dan MS-LS tetapi tidak bagi US-MS. LS mempunyai lebih banyak spesies ikan berbanding US dan MS. Adalah dijangkakan bahawa kewujudan jenis substrat dan mikrohabitat yang berbeza di LS menggalakkan kekayaan spesies. Walaupun saiz sungai adalah kecil, iktiofauna yang dijumpai di Sungai Chantek adalah penting dan patut dikekalkan. Kajian ini telah berjaya mendokumentasikan kepelbagaian spesies ikan di Sg. Chantek. Hasil dapatan mencadangkan agar pemantauan berterusan perlu dijalankan bagi memastikan kepelbagaian spesies dipelihara.

Kata Kunci: ikan, darat, sungai kecil, kekayaaan species

INTRODUCTION

Malaysia has a coverage of about 549 500 km^2 of freshwater bodies, which harbour a wide variety of freshwater fish species (Chong et al., 2010). Freshwater fishes in this region occupied an extensive range of aquatic habitat – from small streams to estuarine, in highly acidic ecosystems and alkaline waters (Ahmad & Khairul-Adha, 2007). There are approximately 470 species currently known to exist in Malaysia (Chong et al., 2010); this number is still an underestimated figure. In Peninsular Malaysia, primary freshwater fish species richness is about 280 species. Until a comprehensive update is made, the number is well underestimated.

Despite being studied since 1800, new species and new record of freshwater fishes in Peninsular Malaysia is still being reported. Surveys in previously unexplored areas and advancement in molecular tools enable cryptic species being discovered, although the rate is much slower nowadays. Records of fish diversity of the similar area increased significantly over time; repeated sampling of freshwater fishes in small streams within Sungkai Wildlife Reserve, Perak had recorded a total of 41 species to date (Amirrudin et al. 2014), increased from what had been previously reported (see Mohd-Sham et al. 2001, 2002, 2005). Fish species richness recorded at Tasik Bera also increased significantly since the first publication some 60 years ago, and to date the total species richness was 127 species (Fahmi-Ahmad et al. 2015). In Tasik Temengor, Perak, the native primary freshwater fishes in the feeding streams and rivers and lake areas are about 42 species (Amirudin & Zakaria-Ismail 2014) since the first publication of Zakaria-Ismail and Lim (1995) with 23 species. These demonstrated that continuous surveys are needed to obtain a better picture of fish diversity in a particular area which may be important for sound conservation and management of aquatic fauna and its ecosystem.

Small streams in Peninsular Malaysia harboured quite a high diversity of freshwater fish. Although the assemblages are taxonomically dissimilar, species composition is closely comparable. In Peninsular Malaysia, many small streams and rivers are still not extensively surveyed for their fish diversity, some have never been surveyed at all especially those that had limited accessibility and in remote areas. A two day scientific expedition organized by the Institute of Agropolis of Universiti Sultan Zainal Abidin (UniSZA) allowed us to study the species composition of freshwater fishes at Sungai Chantek, Pasir Akar, Besut, Terengganu.

MATERIAL AND METHODS

Sungai (Sg.) Chantek located in Pasir Akar, Besut, north of Terengganu (Figures 1a and 1b). It is situated in the farm field under the jurisdiction of Centre of Farm Management UniSZA. The small stream of Sg. Chantek flowed northeast to joint with Sungai Besut which flow north into the South China Sea. Sampling was conducted in the small stream near the base camp, during a scientific expedition from 30th to 31st of October 2015. The lower part (LS) of the stream has a low gradient bank slope, slow to moderate water current with sandy and gravel substrate. The middle part (MS) also with a low gradient bank slope, moderate to fast flowing water and substrate comprises of boulders and pebbles. At the upper part (US) of the stream, bank slope are steep with fast current over mainly boulders, cobbles and bedrock substrates. At each stream section, two 25 m plots were sampled by moving the electrofisher upstream.

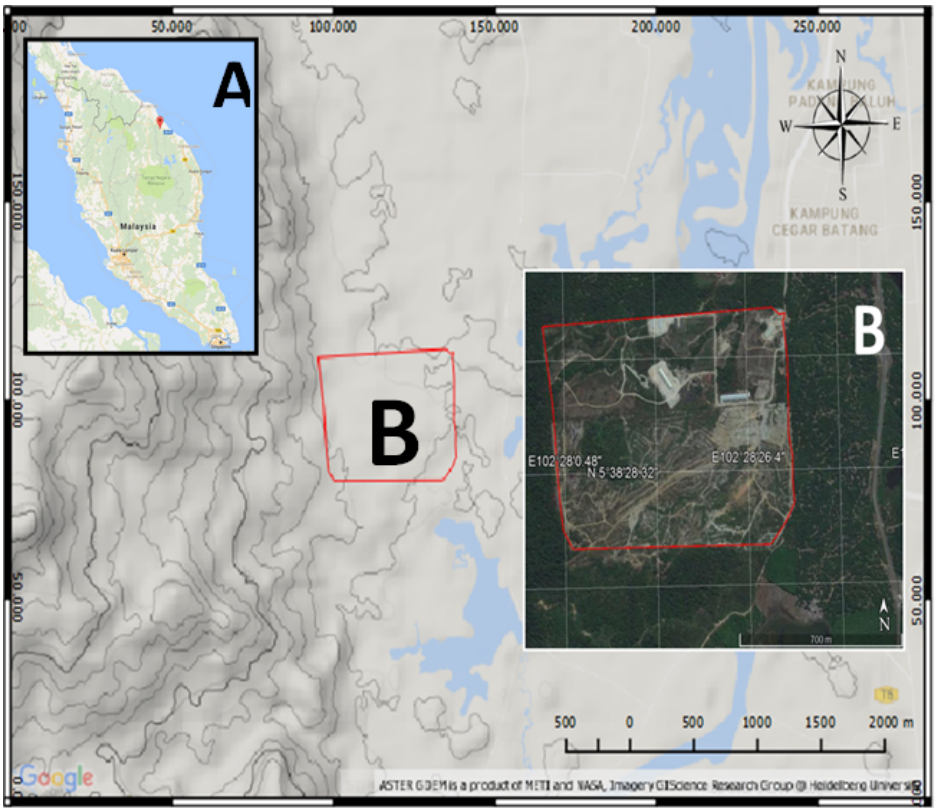

Figure 1. The map of Peninsular Malaysia (A) showing the location of the study site in the state of Terengganu and the map showing the surrounding make up and topographic condition of the sampling area (B).

Fish were sampled using a battery operated backpack electrofisher model LR-24 (Smith Root, Inc., USA). Stunt fishes were collected using scoop nets at slow moving current but a seine net was used to retain stunt fish in fast flowing water. All fishes were released back to the stream immediately after their identity was confirmed. Voucher specimens of selected fishes were preserved in 10% formalin in the field and were transferred into 75% ethanol later for long term preservation. Fishes were identified using Kottelat et al. (1993) and Rainboth (1996). Nomenclature for the fish family follows Kottelat (2013).

RESULTS

A total of 22 species from 12 families were collected during the two days of sampling at Sg. Chantek, Pasik Akar, Besut, Terengganu (Table 1). The most dominant family in this study is Cyprinidae represented by six species (27%) followed by Balitoridae with four species (18%). Families Bagridae and Mastacembelidae contributed two species each. The remaining families were represented by single species. Most of the species recorded at Sg. Chantek are commonly found in many small streams elsewhere in Peninsular Malaysia.

Table 1. Checklist of freshwater fishes collected from Sg. Chantek, Pasir Akar, Besut, Terengganu

No.	Family	Species
1.	**Cyprinidae**	*Barbodes binotatus*
5.		*Garra cambodgiensis*
2.		*Hampala macrolepidota*
4.		*Mystacoleucus obtusirostris*
3.		*Poropuntius smedleyi*
6.		*Rasbora paviana*
7.	**Balitoridae**	*Balitoropsis zollingeri*
8.		*Homaloptera parclitella*
9.		*Homalopteroides nebulosus*
10.		*Pseudohomaloptera* cf. *leonardi*
11.	**Nemacheilidae**	*Nemacheilus selangoricus*
12.	**Amblycipitidae**	*Amblyceps foratum*
13.	**Sisoridae**	*Glyptothorax fuscus*
14.	**Clariidae**	*Clarias leiacanthus*
15.	**Bagridae**	*Batasio fluviatilis*
16.		*Hemibagrus capitulum*
17.	**Synbranchidae**	*Monopterus javanensis*
18.	**Mastacembelidae**	*Macrognathus circumcinctus*
19.		*Mastacembelus favus*
20.	**Gobiidae**	*Glossogobius giuris*
21.	**Osphronemidae**	*Betta pugnax*
22.	**Channidae**	*Channa gachua*

The dominance-diversity curve depicted that the fish community in Sg. Chantek followed a log-normal distribution which a few species were highly abundant and many were rare which represented only by a few individuals. In this study fish composition was dominated by *Poropuntius smedleyi* with 140 individuals collected (Figure 2). Four lowest ranking species that represented by a single individual were *Amblyceps foratum*, *Glyptothorax fuscus*, *Clarias leiacanthus*, and *Balitoropsis zollingeri*.

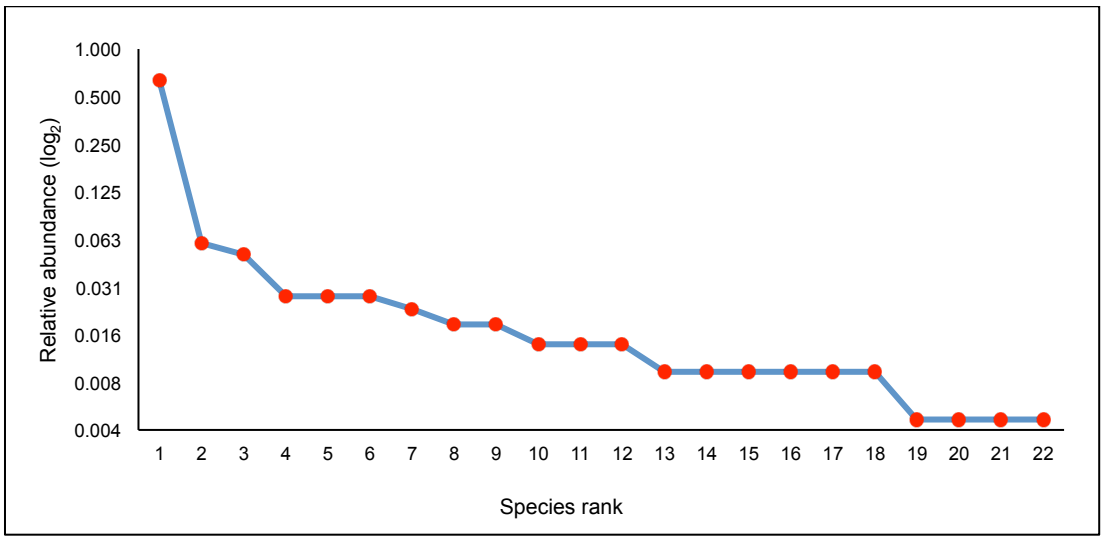

Figure 2. Dominance-diversity curve of freshwater fish in Sg. Chantek

More fish were collected in the downstream section (85 individuals) compare to middle and upper stream sections (Table 2). Fish species richness for each section range from 12 (US) to 18 (LS). Analysis of species richness using rarefaction showed that the lower stream (LS) section was significantly richer than that of middle and upper stream sections (Figure 3) as the 95% confidence interval (CI) of lower stream fish community was not overlapped with CIs of both middle (MS) and upper stream (US) curves. MS-US curve did not significantly difference.

Fish community at US showed high dominance index value compared to the middle and lower stream sections, but none is significantly different ($p>0.05$). The Simpson diversity index was highest at lower stream section compared to that at the other two stream section. However, none were significant difference. The Shannon diversity index was highest at the lower stream section and it was significantly higher than that of the upper stream section ($p = 0.037$) but not significantly different from the value at the middle stream section ($p>0.05$). Species richness indices of Menhinick and Margalef showed that the fish community at the lower stream section was richer than the other two sections but none were significantly different ($p>0.05$). Evenness index values for all sections were low and not significantly different ($p>0.05$). Similarly, the equitability index among the stream sections were not significantly different and the values range from 0.51 (US) to 0.64 (LS). Chao-1 species estimator estimated a total of 40, 28, and 24 species could be expected from each stream section, much bigger that what was recorded during the survey for US, MS and LS, respectively. For overall species richness, Chao-1 estimated 23 species, only short one species from the observed species (22). The estimated number of species richness based on the species composition at each stream section ranges from 24 species (LS) to 40 species (US). Predicted species richness at the lower stream section is much better (six species more than observed richness) that that of the other two sections.

Figure 3 showed the rarefaction curves comparing the three stream sections at Sg. Chantek. The results indicated that the lower stream (LS) section was significantly different from the other two stream sections (MS and US). It was also found that there were no significant differences between that MS and US as the 95% confidence intervals between the two curves were not independent from each other.

DISCUSSION

Cyprinidae approximately have 3000 species in 370 genera which makes it the largest fish family (Froese & Pauly 2015; Nelson 2006). Fish from the family Cyprinidae are commonly found in water bodies in Peninsular Malaysia and their composition is usually high reaching up to 40% of the total assemblages (Zakaria-Ismail, 1993). However, in this study the cyprinids contributed less than 30% of the total species recorded. Cyprinids composition at Sg. Chantek was low compared to the previous studies such as more than 42% in Sungkai (Amirrudin et al. 2014) or 50% recorded at the upper part of Sg. Timah Tasoh in Perlis (Abdullah et al. 2002). This study was done in general, at the headwater habitat-type stream that has less microhabitat diversity – dominant substrate was rocky that lack of pools and bank cut habitats. A small number of cyprinids recorded in this study could be contributed by the small stream size of Sg. Chantek. Small stream size offers limited habitat diversity, hence limits species diversity (Gorman & Karr 1978; Casatti 2005).

Table 2. Fish species composition for each stream section at Sg. Chantek and their diversity measures. LS = lower stream, MS = middle stream, US = upper stream

Species	US	MS	LS	Total
Amblyceps foratum	0	0	1	1
Baliteropsis zollingeri	1	0	0	1
Barbodes binotatus	5	1	7	13
Batassio fluviatilis	3	2	1	6
Betta pugnax	0	4	1	5
Channa gachua	0	1	1	2
Clarias lieacanthus	1	0	0	1
Garra cambodgiensis	3	3	5	11
Glossigobius guirus	0	1	1	2
Glyptothorax fuscus	1	0	0	1
Hampala macrolepidota	0	1	1	2
Hemibagrus capitulum	0	1	3	4
Homaloptera parclitella	0	1	1	2
Homalopteroides nebulosus	0	0	3	3
Macrognathus circumcinctus	1	3	2	6
Mastacembelus favus	1	3	2	6
Monopterus javanensis	1	1	0	2
Mystacoleucus obtusirostris	0	0	2	2
Nemacheilus selangoricus	1	1	1	3
Poropuntius smedleyi	44	49	47	140
Pseudohomaloptera cf. *leonardi*	1	0	2	3
Rasbora paviana	0	0	4	4
Diversity measures				
Taxa richness (S)	12	14	18	22
Number of individuals	63	72	85	220
Dominance (D)	0.50	0.47	0.32	0.42
Simpson (1-D)	0.50	0.53	0.68	0.58
Shannon (*H'*)	1.27	1.39	1.85	1.66
Evenness	0.30	0.29	0.35	0.24
Equitability (*J'*)	0.51	0.53	0.64	0.54
Menhinick	1.51	1.65	1.95	1.48
Margalef	2.66	3.04	3.83	3.89
Species richness estimation				
Chao-1	40	28	23.6	22.86

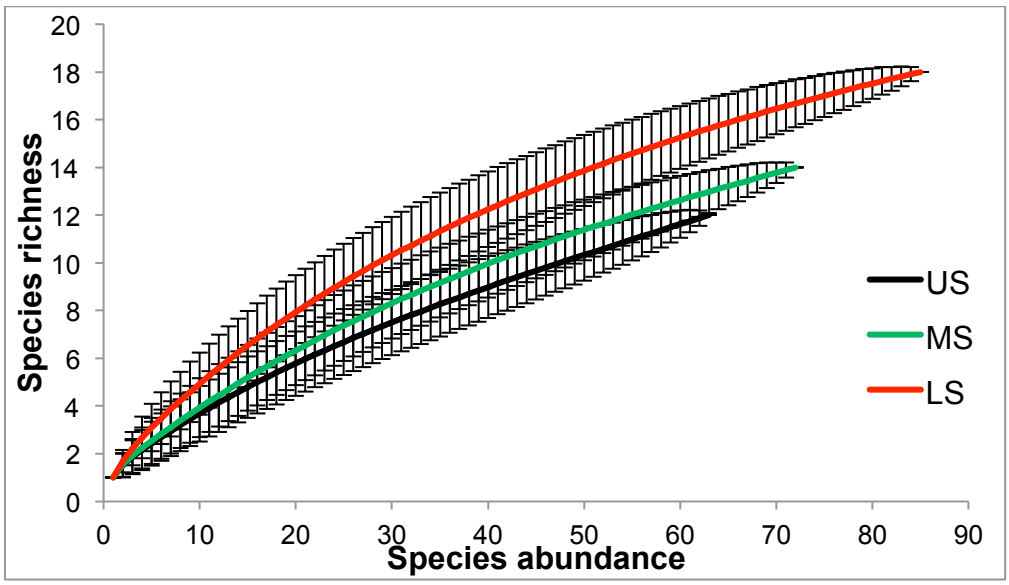

Figure 3. Rarefaction curves for the three stream sections at Sg. Chantek. The vertical bars indicate the 95% CI for each curve. Overlapping of the CI indicates no significant differences between curves.

Among cyprinids, *Poropuntius smedleyi* was the most common fish species found in this study. This species is also common in many headwater streams throughout Peninsular Malaysia (Amirrudin et al. 2014) except in Perlis and Kedah where it was absent. When present, *Poropuntius smedleyi* a natural resident of the headwater streams that have generalized trophic structures (Roberts 1998) can be very abundant. Therefore it was not surprising that this fish is also abundant at Sg. Chantek. The morphological features of *Poropuntius smedleyi* i.e. possessed streamline body with wide and deep caudal peduncle, provide the best adapted to live in the fast and strong water current (Beamish et al. 2006) as in Sg. Chantek.

Species distribution pattern of fish community recorded at Sg. Chantek is similar to the pattern of organisms in species-rich area or high biodiversity region where many species are usually found in a small number of individual compared to a few that are highly abundant (Magurran 2005). A total of 10 species with a small number of individuals (i.e., singletons and doubletons, see Table 2) was found at Sg. Chantek represent approximately 50% of the total fish community. The occurrence of many rare species and less abundant species is common in nature. This could be due to the sampling bias (e.g., sampling intensity [Magurran 2005]) during the inventory program, but it could be because of the nature of the organisms itself that is known as a 'global uniques', meaning those that were found in a small number of individuals in the survey regardless of what the sampling intensity was. Rarity of species that lies on the right side of the tail (Figure 2) could also be those that are known as "methodological edge species" (Longino et al. 2002), meaning species that are possibly abundant at the site but difficult to sample because of their microhabitat hence, the present sampling gear employed in the study was not good enough to capture the realistic picture of the species found in certain habitats at Sg. Chantek. As previously mentioned, further sampling could overcome this discrepancy.

In general, longitudinal changes in fish diversity are pronounced (Casatti 2005). However, for a small stream like Sg. Chantek, where stream sections studied relatively close to one another, longitudinal diversity measures were not noticeable. This could be due to the ability of fish to move between downstream and upstream without any obstruction. When fish movement in the stream is not obstructed, dispersion of species among stream section are uniform. Hence, their diversity measures did not show any significant differences except for the Shannon diversity index. The Shannon diversity index is a common index of diversity that rely greatly on species evenness and locally abundant species. Due to high dominance at US and high evenness at LS, the value of H' between the two stream sections tend to differ slightly. However, we believe that if sampling effort were equal, differences in diversity measures of each stream section can be eliminated.

Variations of species richness among stream sections were only pronounced at LS (18 species) and the graphical examination of species richness with the other stream sections demonstrated that it has significantly more species. We hypothesize that the presence of different substrate types and microhabitats promotes species richness (Gorman & Karr 1978, Casatti 2005). Observed species richness of fish community at Sg. Chantek does not vary much from the expected Chao-1 value (22 vs. 23 species, Table 2). The result showed that sampling effort

employed in this study was enough to record all species inhabiting the stream. Based on the data, further sampling might not significantly increased species richness.

Sg. Chantek is situated within an agrofarm where the stream water quality might be influenced greatly by the activities within the catchment. For as long as the influx of nutrients or the land used surrounding the stream is not significantly altered, fish diversity in Sg. Chantek will not be affected. However, we would like to suggest for a continuous monitoring to be done to ensure species diversity is preserved. Despite of its small size stream, the ichthyofauna found here are important and should be kept intact.

CONCLUSION

This study has resulted a collection of 22 species from 12 families of freshwater fishes representing a significant number of the most common freshwater vertebrate inhabiting Sg. Chantek. The differences between stream sections were only between US-LS and MS-LS but not MS-LS. More species could be expected from the LS but observed species richness at MS and US were closer to the predicted value given by Chao-1. Although most of the species can be found in many streams and rivers in the country, these species are worth keeping and can be used as a bioindicator species for water quality monitoring tools. The current study shows that freshwater fish at Sg. Chantek is equally diverse and comparable to other stream of similar size in other parts in Peninsular Malaysia. If the surrounding area of Sg. Chantek is properly maintained, the diversity of fish in the streams will continue to exist and benefit the ecosystem in general.

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REFERENCES

Abdullah, S., Amirrudin, A., Usup, G., & Maimon, A. (2002). Fishes of Perlis State Park with reference to its habitat environment and conservation. In A. Latiff, K. Osman, Faridah-Hanum, I. and A. Rahman, Y. (Eds.). Kepelbagaian Biologi dan Pengurusan Taman Negeri Perlis: Persekitaran Fizikal dan Biologi dan Sosio-ekonomi Wang Mu. Taman Negeri Perlis & Jabatan Perhutanan Perlis. Pp 135-147.

Ahmad, A., & Khairul-Adha, A. R. (2007). State of Knowledge on Freshwater Fishes of Malaysia. *Status of Biological Diversity in Malaysia & Threat Assessment of Plant Species in Malaysia.* Pp 79-86.

Amirrudin B. A., Fahmi-Ahmad, M., & Syed A. R. (2014). Fish diversity in small streams of Sungkai Wildlife Reserve, Perak, Malaysia *Journal of Wildlife and Parks* 29: 13-21.

Amirrudin, A., & Zakaria-Ismail, M. (2014). Additional native fish fauna of rivers and streams flowing into Temengor reservoir, Perak, Malaysia. *Malayan Nature Journal* 66(4): 407-419.

Beamish, F. W. H., Sa-ardrit, P., & Tongnunui, S. (2006). Habitat characteristics of the cyprinidae in small rivers in Central Thailand. *Environmental Biology of Fishes*, 76 (2): 237-253.

Casatti, L. (2005). Fish assemblage structure in a first order stream, southeastern Brazil: longitudinal distribution, seasonality, and microhabitat diversity. *Biota Neotropica*, 5(1), 75-83. https://dx.doi.org/10.1590/S1676-06032005000100009.

Chong, V. C., Lee, P. K. Y., & Lau, C. M. (2010). Diversity, extinction risk and conservation of Malaysian fishes. *Journal of Fish Biology,* 76: 2009–2066.

Fahmi-Ahmad, M., S. A. Rizal & Amirrudin, B. A. (2015). Ichthyofaunal diversity of Tasek Bera, Pahang, Peninsular Malaysia. *Journal of Wildlife and Parks* 30: 27-44.

Froese, R., & Pauly, D. (2015). FishBase. World Wide Web electronic publication. Available from www.fishbase.org. (Version on November 2015).

Gorman, O.T., & Karr, J.R. 1978. Habitat structure and stream fish communities. *Ecology* 59:507-515.

Kottelat, M. (2013). The fishes of the inland waters of Southeast Asia: a catalogue and core bibliography of the fishes known to occur in freshwaters, mangroves and estuaries. *Raffles Bulletin of Zoology*, Supplement 27: 1–663.

Kottelat, M., Whitten, A. J., Kartikasari, S. N., & Wirjoatmodjo, S. (1993). *Freshwater fishes of western Indonesia and Sulawesi*. Periplus Editions, Hong Kong 219 pp.

Longino, J. T., Coddington, J. & Colwell, R. K. (2002). The ant fauna of a tropical rain forest: estimating species richness three different ways. *Ecology*, 83(3): 689-702.

Magurran, A.E. (2005). Species abundance distributions: pattern or process? *Functional Ecology,* 19: 177–181.

Mohd-Sham, O., Shukor, M. N., & Awangku-Jalaludin, P. B. (2002). A preliminary survey of stream fishes of Sungai Ulu Bikam in Sungkai Wildlife Reserve, Perak. *Jurnal Biosains,* 13(1): 43–48.

Mohd-Sham, O., Shukor, M. N., Muzamil, M., & Ak-Jalalludin, P. B. (2001). Checklist of fish species of Sungai Suar stream system in Sungkai Perak. *Journal of Wildlife & Parks,* 19: 67-74.

Mohd-Sham, O., Shukor, M. N., Ng, C. M., & Lee, S. M. (2005). Stream fishes of Sungkai Wildlife Reserve, Perak. *Journal of Wildlife & Parks,* 22: 111-118.

Nelson, J.S. (2006). *Fishes of the World*, (4th ed.) Wiley, New York, NY. 622 pp.

Rainboth, W. (1996). *FAO Species Identification Field Guide for Fishery Purposes*. Fishes of the Cambodian Mekong. FAO, Rome, xi + 265 pp., 27 pls.

Roberts, T. R. (1998). Review of tropical Asian cyprinid fish genus *Poropuntius,* with descriptions of new species and trophic and morphs. *Natural History Bulletin of the Siam Society*, 46:105-135.

Zakaria-Ismail, M. (1993). The fish fauna of the Sungai Teris and Sungai Rengit, Krau Game Reserve, Pahang, Malaysia. *Malayan Nature Journal*, 46: 201-228.

Zakaria-Ismail, M., & Lim, K. K. P. (1995). The fish fauna of Tasik Temengor and its tributaries south of Banding, Hulu Perak, Malaysia. *Malayan Nature Journal*, 48: 319-332.